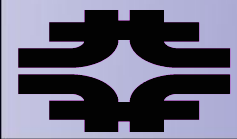


Plans for a New Front-End for the existing FNAL Linac

C.Y. Tan/W. Pellico
8 Sep 2010
Project X Collaboration Meeting 2010



People (Additional Help – Needed/Requested)

- ♦ AD people:

- ♦ W. Pellico (head of proton source), C.Y. Tan, J. Lackey, D. Bollinger, K. Duel, R. Riley, V. Scarpine.

- ♦ TD people:

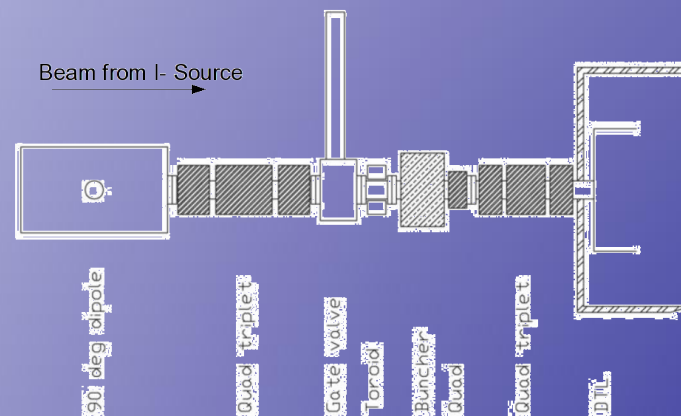
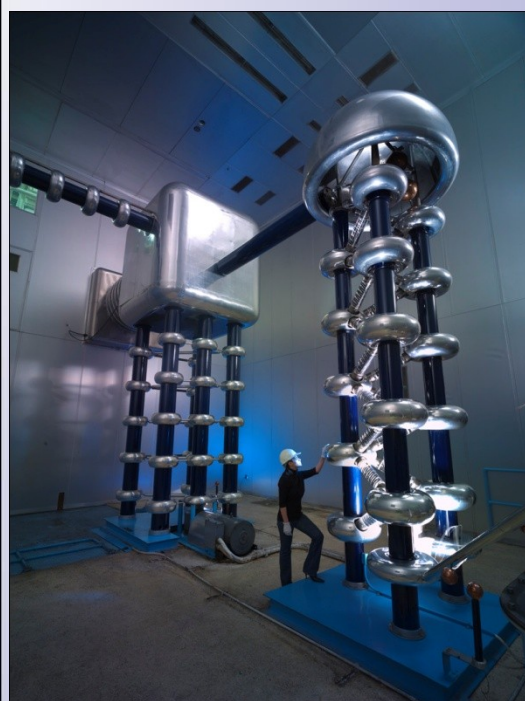
- ♦ G. Velez, V. Kashikhin, A. Makarov

- ♦ Thanks to BNL pre-injector group

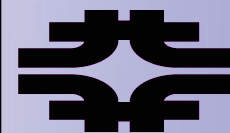
- ♦ J. Alessi, D. Raparia, M. Okamura, V. Lodestro.



Present Injector – Vintage 1968 Hardware

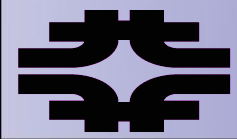


- Magnetron Source
 - 35 keV ribbon beam
 - Current about 50-60mA
- Cockcroft Waltons
 - 750keV
 - Current about 45 - 55 mA
- MEBT section
 - Quads and buncher before Tank 1
 - Dipole to accommodate another H- source + Cockcroft Walton



Reasons for Upgrade

- ◆ The components are getting harder to maintain
 - ◆ Critical personnel have retired.
 - ◆ Components getting harder to find and replace
 - ◆ Critical failure of I- column in early 2010 which required a rebuild.
- ◆ As system ages, more time and attention required to maintain reliability of system.
- ◆ Going to RFQ system should increase beam quality and system reliability.
 - ◆ Very good results from BNL when they switched from Cockcroft-Walton to RFQ system. Done in 1989. (21 years late to the party)

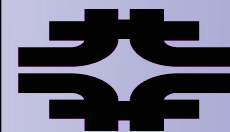
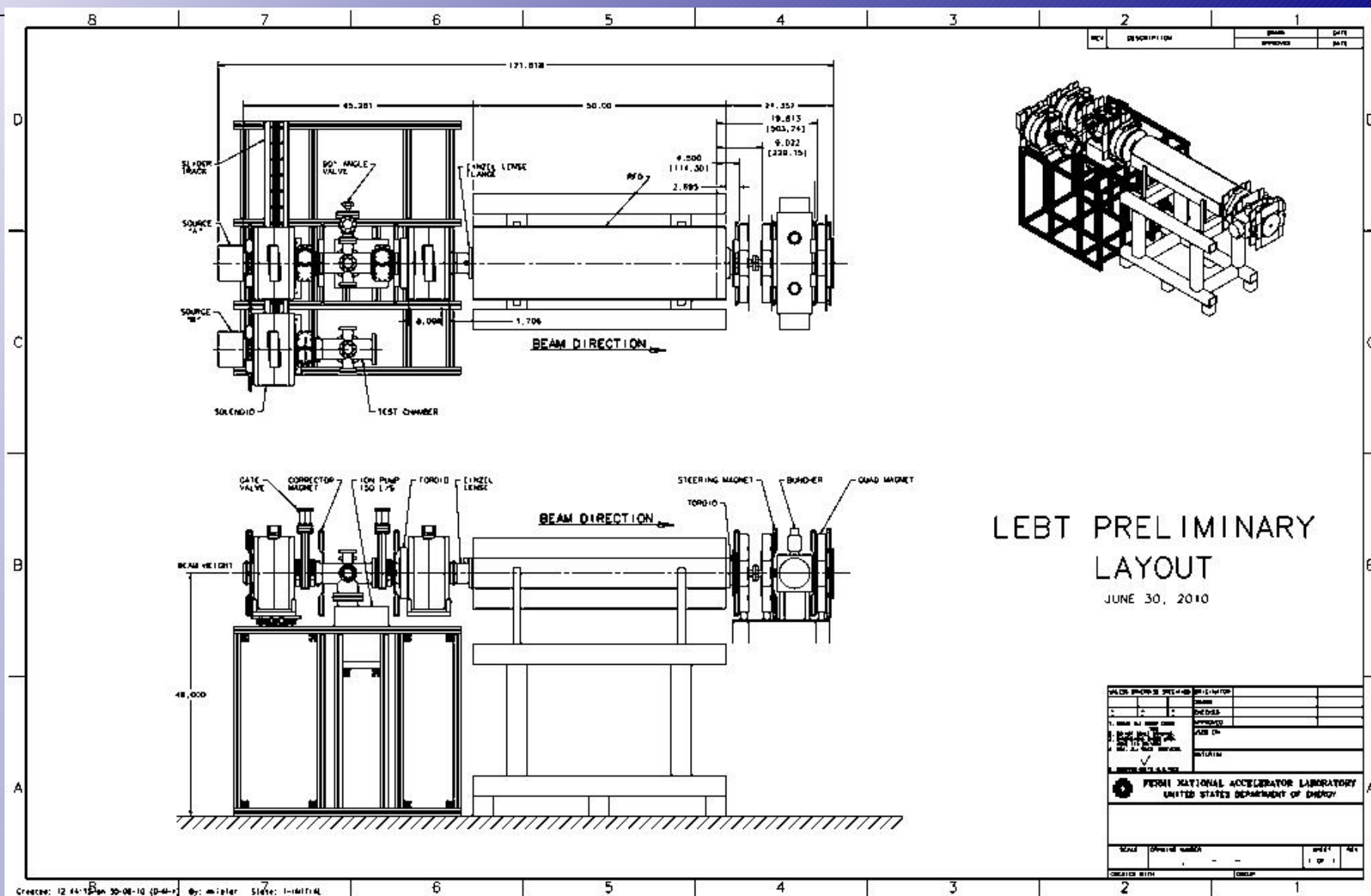


Objectives

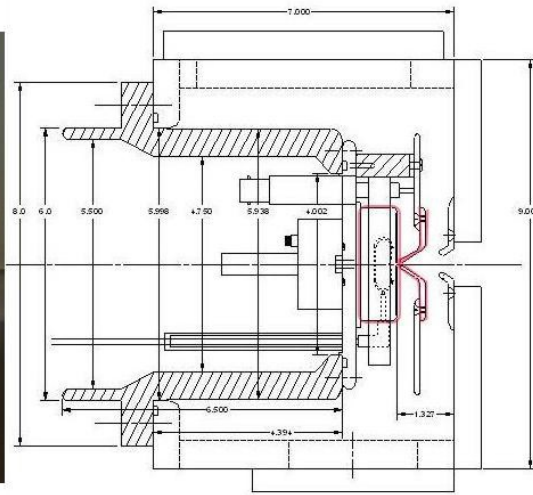
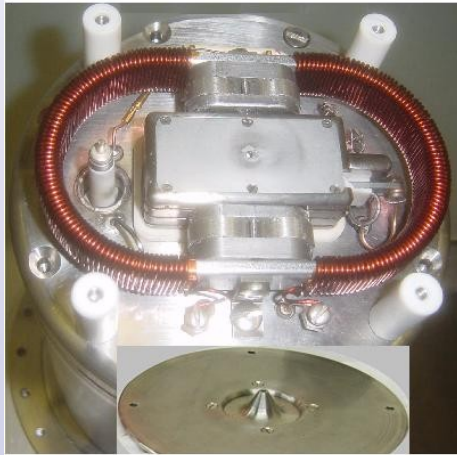
- ♦ This is not an R&D project
- ♦ Copy as much as possible from an existing injector
 - ♦ BNL injector is used as basis of design.
- ♦ Use as much as possible existing infrastructure, technology and expertise.
- ♦ Convert slit magnetron source to round magnetron source
 - ♦ BNL style source. Very good reliability and performance > 90mA at 500 us, more than 6 months before any change required.
 - ♦ 750keV RFQ 60mA 200MHz (not technology limited)
- ♦ Better performance
 - ♦ At least 10-15% improvement in efficiency to Booster.
- ♦ Support future operations – Nova, Mu2E, MicroBooNE, G-2, RunIII



Overall Design

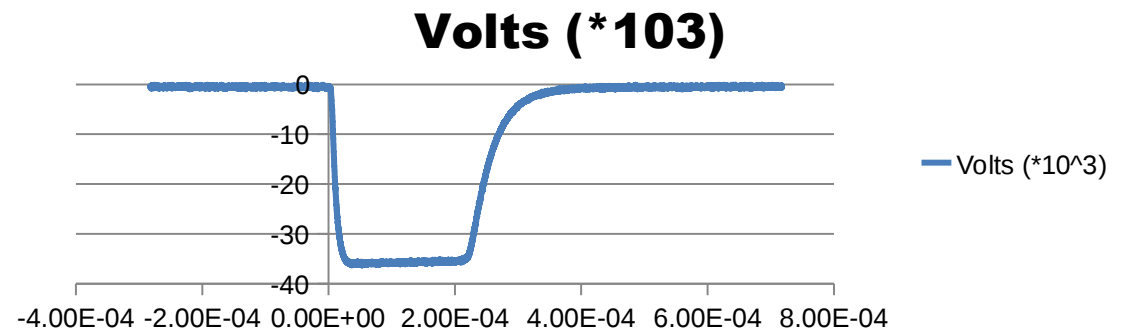
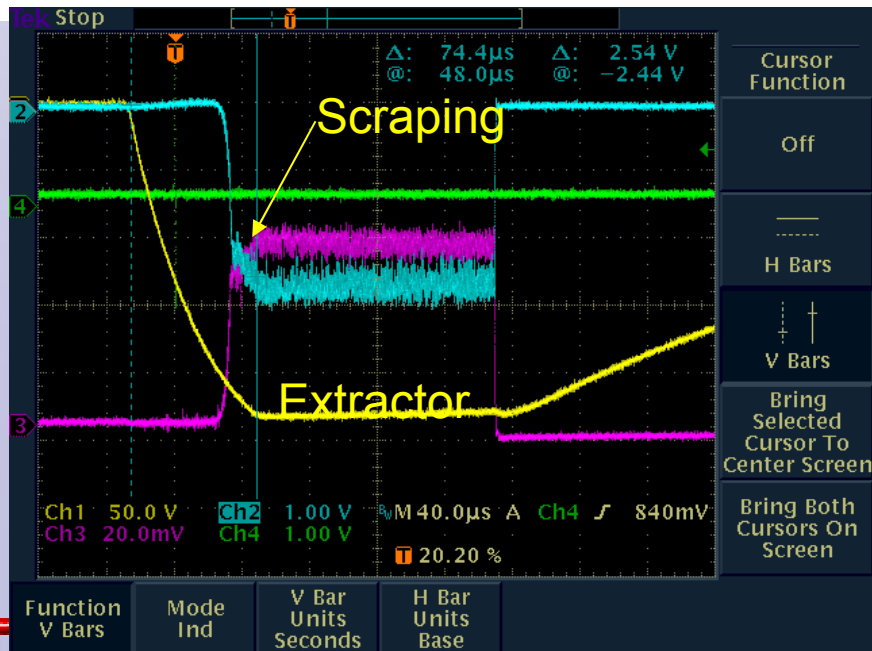


The H- Source

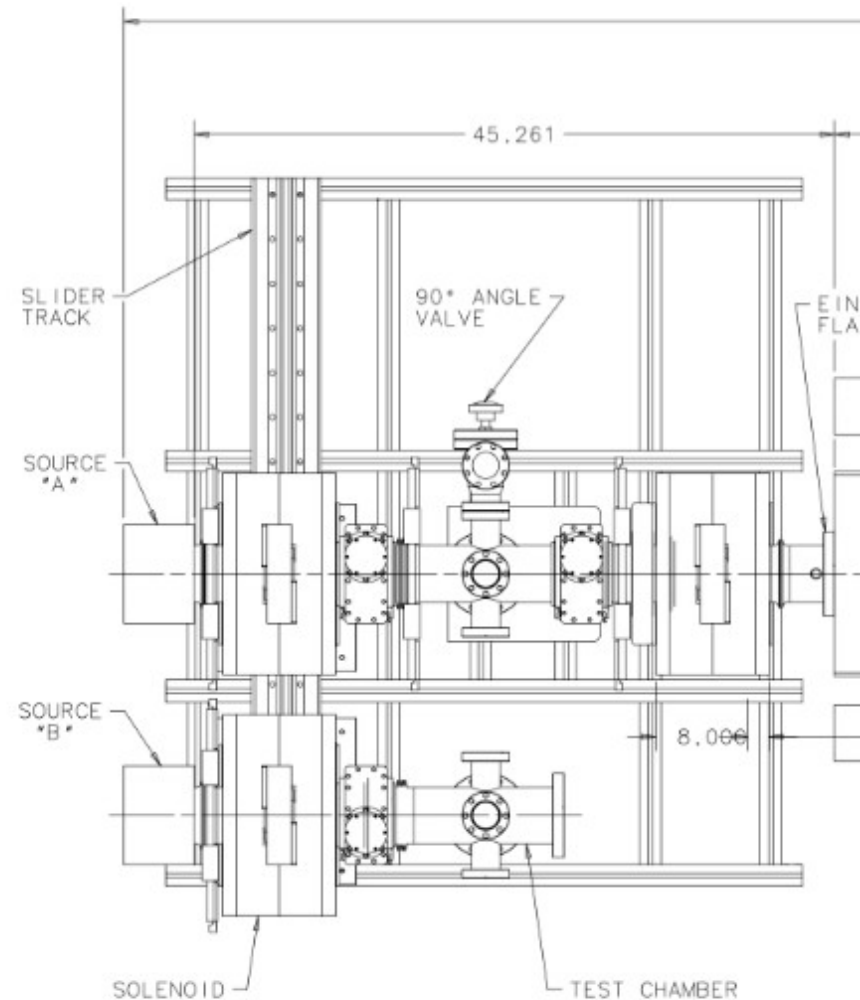
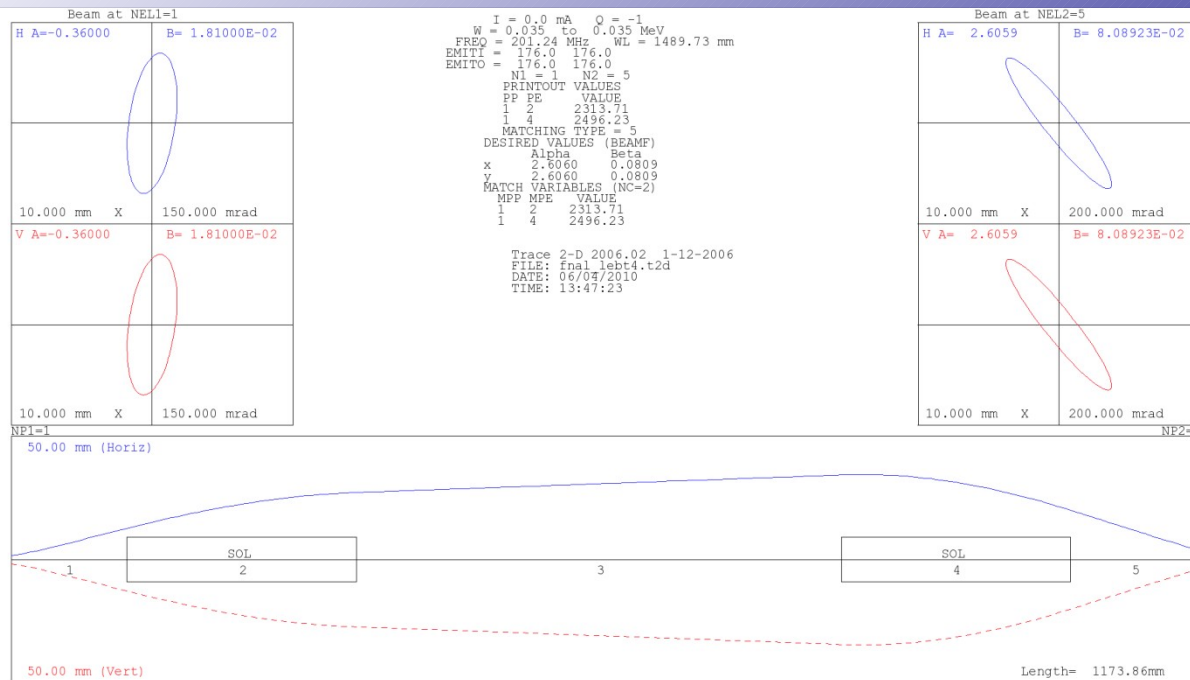


In the process of bringing up the H- source

- 60mA at 26kV extraction voltage
- Should get 90mA at 35kV extraction.



LEBT

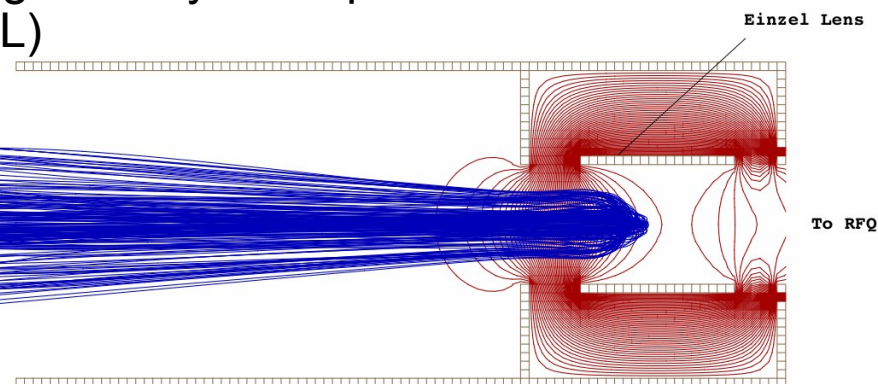


- LEBT < 1.2 m long
- 2 sources for reliability.
- Will probably use Xe gas neutralization of H-
- Solenoids are being built right now. Delivery expected by the end of the year.

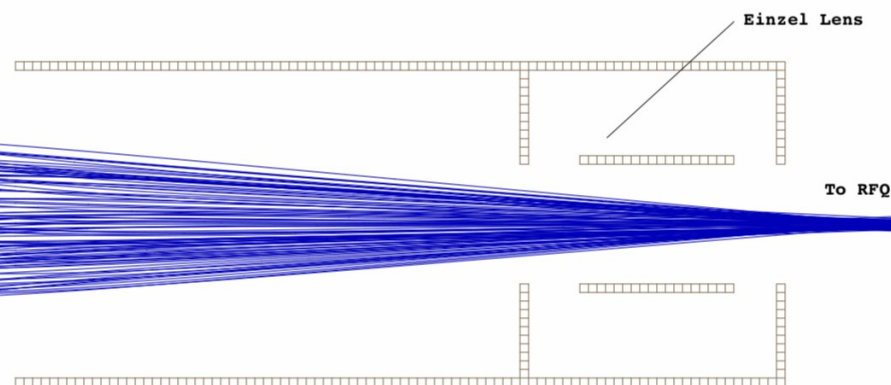


Chopper

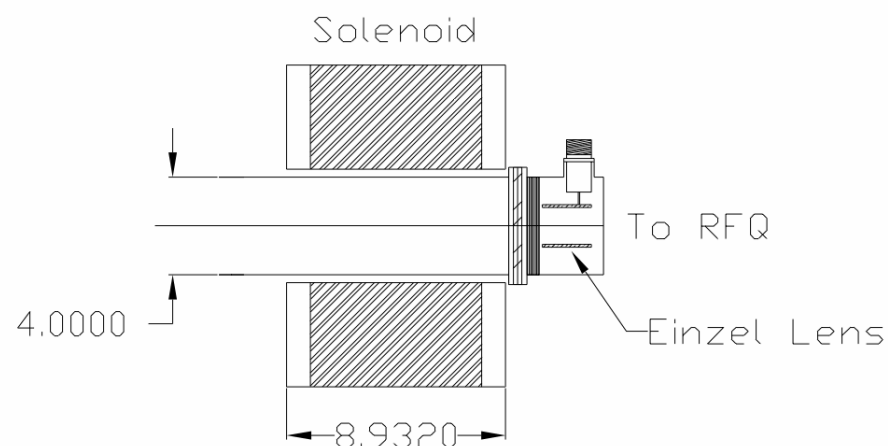
Suggested by D. Raparia
(BNL)



Einzel Lens On at -36kV



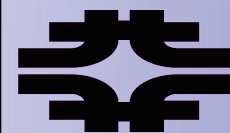
Einzel Lens Off



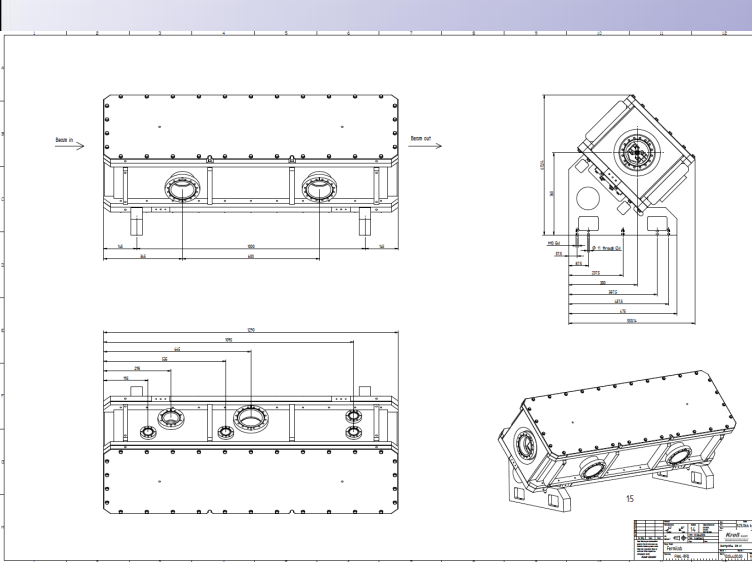
Preliminary experiments have shown that Einzel lens will not spark at 37kV with or without H-

Reason for chopper

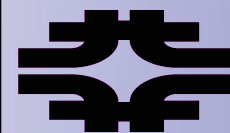
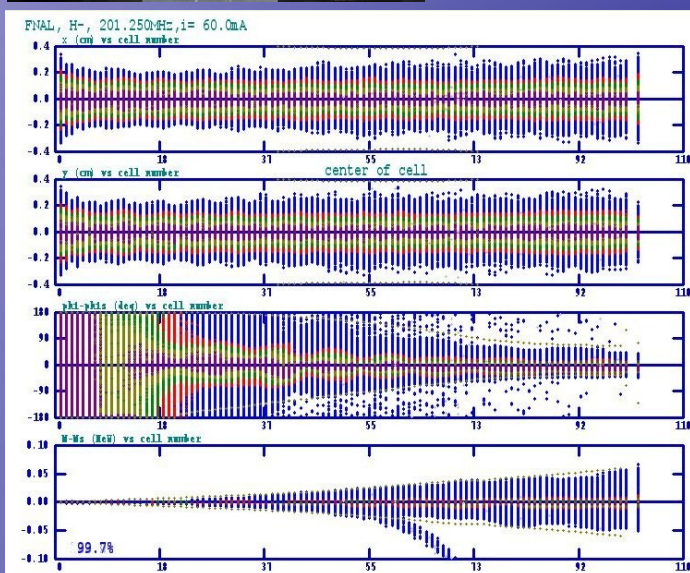
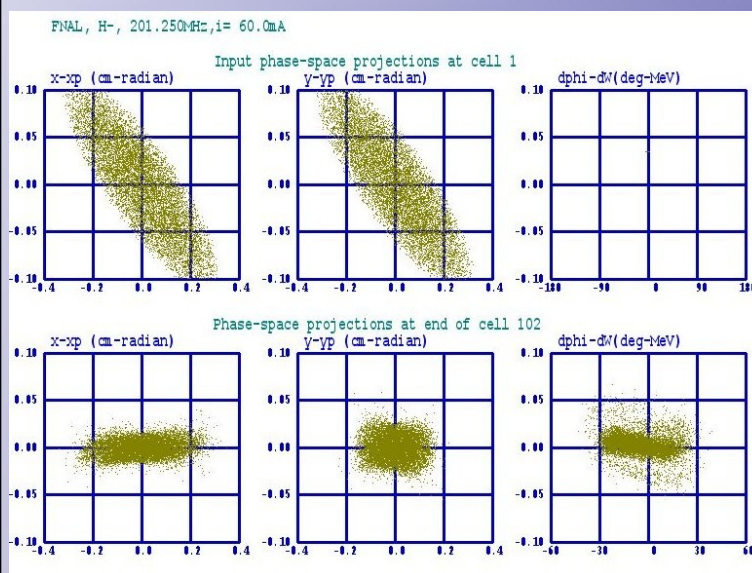
- Want rise/fall time of H- < 1us.
- Want control of length of pulse.



RFQ



- 750keV RFQ.
- 60mA beam current
- 1.3m long.
- Rod design.
- Alwin Schempp designer
- Expected delivery, early 2011

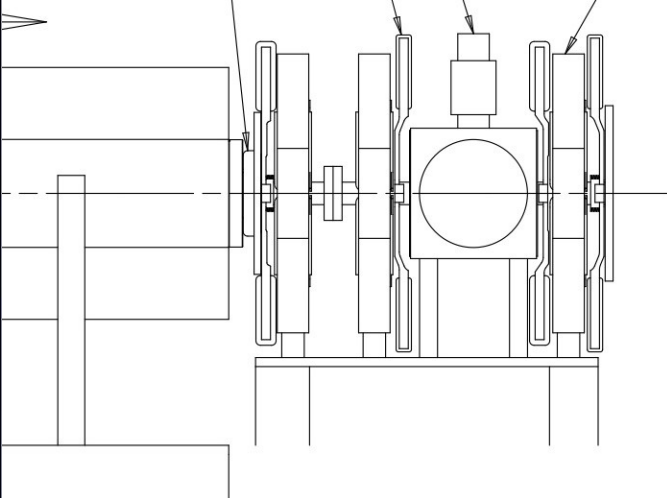


Fermilab,
P.O. Box 500
Batavia, IL 60510

MEBT

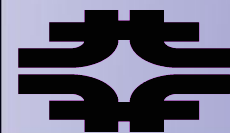
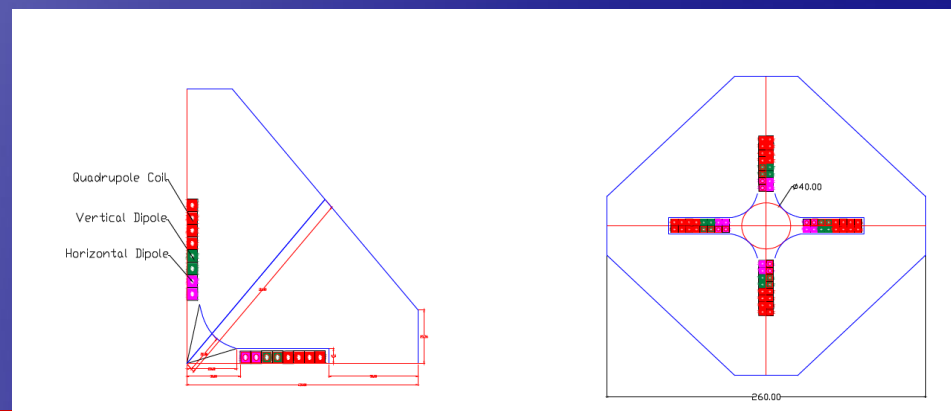
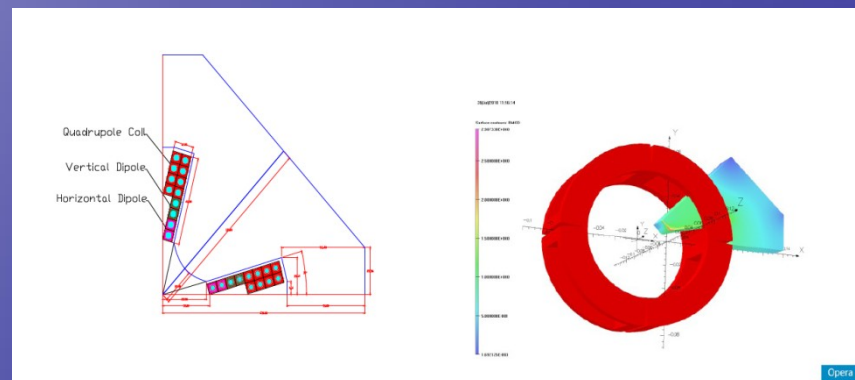
STEERING MAGNET BUNCHER QUAD MAGNET

TOROID



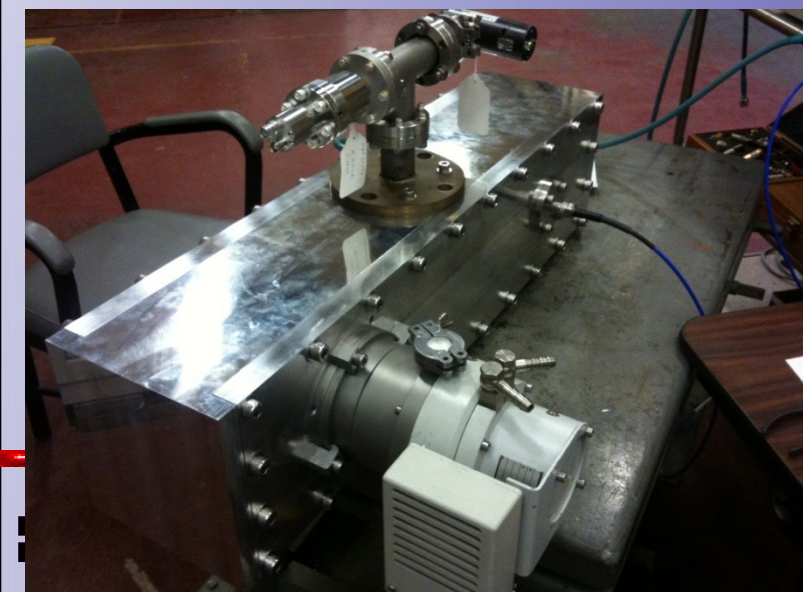
Near identical copy of BNL MEBT

- Only 73.25 cm long
- Buncher will be bought from Time.com (Japan)
- Quads (45mm) being designed in TD with correction dipoles



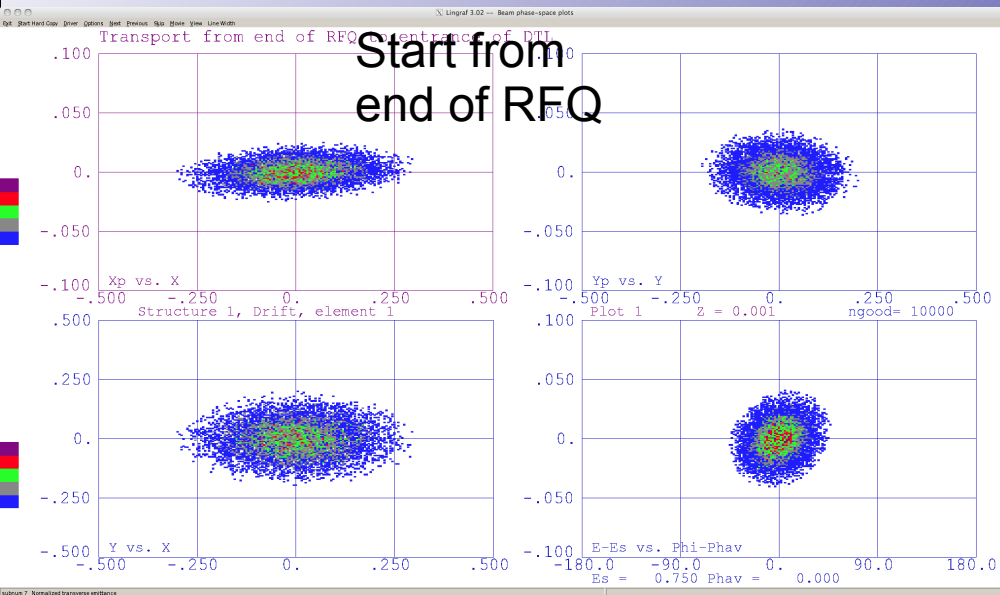
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Batavia, IL 60510

Buncher



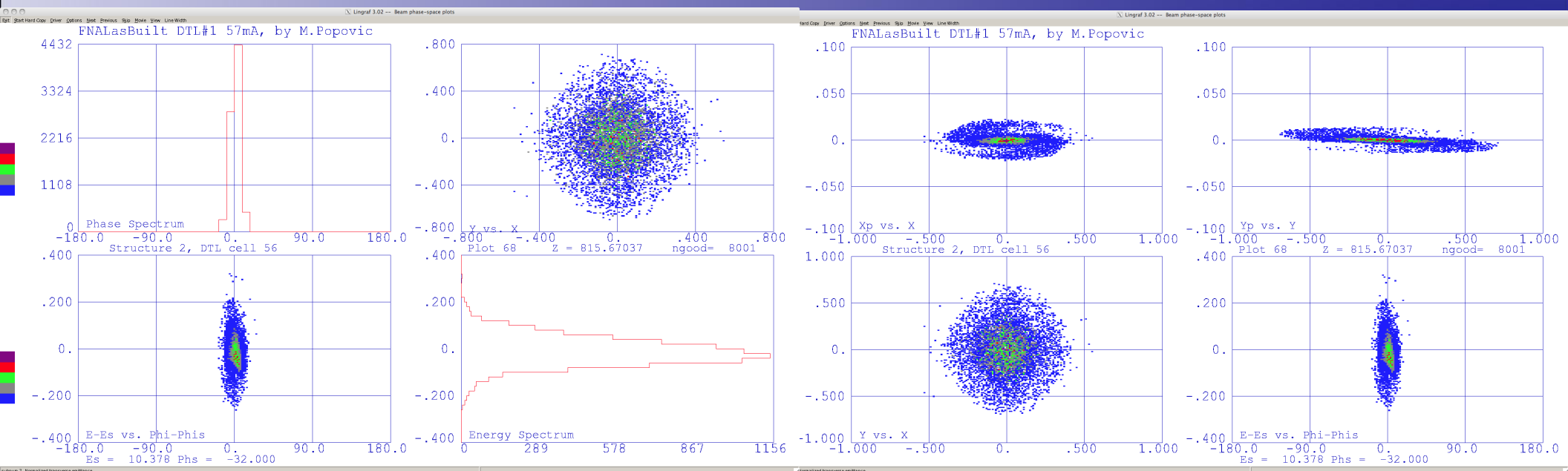
Pictures from
BNL. Thanks to
M. Okamura.

Parmila Simulations



Using 60mA beam from end of RFQ to end of Tank 1 we get 80% capture (without optimizing the quad strengths in Tank 1)

End of Tank 1



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Batavia, IL 60510

Conclusion

- ◆ Goal is to complete testing of injector before the shutdown of 2011.
- ◆ Installation will probably take 3 months
- ◆ Lots of things to do before then
 - ◆ Complete commissioning of the H- source
 - ◆ Test Einzel lens as chopper.
 - ◆ Check and condition buncher.
 - ◆ Check and condition RFQ
 - ◆ Have test stand ready for beam test
 - ◆ Build and complete solenoids.
 - ◆ Build and complete quadrupoles.

